

Iatrogenic superior mesenteric vein injury: the perils of high ligation

M. R. Freund¹ · Y. Edden¹ · P. Reissman¹ · A. Dagan¹

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Abstract

Purpose The purpose of this review is to highlight the perils and pitfalls associated with high vascular ligation during right colectomies for adenocarcinoma and to identify the various mechanisms of injury to the superior mesenteric vein (SMV) and its tributaries.

Methods This is a retrospective chart review of 304 right colectomies (159 open and 145 laparoscopic) performed over a period of 10 years (1 June 2006–31 May 2016) for right-sided colonic adenocarcinoma in an academic medical center.

Results During a 10-year study period, we encountered five cases in which significant damage to the SMV and its tributaries occurred. This accounts for a total of 1.6 % of all right colectomies performed for colonic adenocarcinoma.

Conclusions Iatrogenic superior mesenteric vein injury is a rare, severe, and underreported complication of both open and laparoscopic right colectomy for colonic adenocarcinoma. We identified several mechanisms of injury such as anatomic misperception, excessive traction and pulling on the venous system, extensive tumor involvement of the mesentery, and uncontrolled suturing attempts at hemostasis. We believe that increased awareness of this complication with profound understanding of vascular anatomy and the different mechanisms of injury will allow surgeons to avoid this often devastating complication.

Keywords Superior mesenteric vein (SMV) · Iatrogenic · Right colectomy · Colonic adenocarcinoma · High ligation · Complete mesocolic excision (CME)

Introduction

The classic surgical approach for resection of malignant colonic tumors includes removal of the primary tumor with adequate proximal and distal margins and the removal of the anatomically defined mesenteric lymphovascularity, thus achieving circumferential resection margins with removal of regional lymph nodes. This approach has been effectively proven in both open as well as laparoscopic colonic surgery to improve local control and survival rates [1]. In 1986, rectal cancer surgery was revolutionized by the work of Heald and associates, claiming improved local recurrence rates and survival rates for rectal cancer patients undergoing total mesorectal excision [2]. The same principles for rectal cancer were applied to colonic surgery and are now widely known and practiced as complete mesocolic excision (CME) [3]. This technique improves on the classical resection principles by achieving a far more radical excision of the lymphovascular pedicle and mesocolon. The practical application of this technique in right colectomies includes adequate removal of the involved colon along with high ligation of its supplying vessels. An important landmark in these anatomic resections is the middle colic vein (MCV) and its tributaries. These veins are usually thin-walled and prone to be torn by excess pulling and traction which may lead to tearing of the superior mesenteric vein (SMV). Right colectomy, although considered a straightforward procedure, carries this ominous threat if anatomical principles are not strictly practiced. We present a series of five patients who underwent open and laparoscopic surgical resection of the right colon with CME and high

✉ M. R. Freund
mikifreund@hotmail.com

¹ Department of General Surgery, Shaare Zedek Medical Center, Affiliated with the Hebrew University School of Medicine, Jerusalem, Israel

vascular ligation principles in whom we encountered inadvertent SMV injury. In our review of the literature, we found such injuries to be only scarcely reported.

Materials and methods

In a constantly updated institutional database, we retrospectively reviewed all right and right extended colectomies performed for colonic adenocarcinoma during a 10-year study period (1 June 2006–31 May 2016). Based on the data gathered, we present a retrospective chart review in which five cases of SMV injury occurred.

Results

During a 10-year study period, a total of 731 right and right extended colectomies were performed in our institution (366 laparoscopic, 365 open). During this period, a total of 304 right colon resections for adenocarcinoma were performed, of those 159 were done in an open technique and 145 laparoscopic or laparoscopic assisted. Throughout the study period, we encountered five cases in which damage to the SMV and its tributaries occurred, all during surgery for adenocarcinoma. These cases account for a total of 1.6 % of all right colectomies performed for colonic adenocarcinoma.

Diagnosis

The damage to the mesenteric vein vasculature was recognized during the initial operation in only two of the five patients. In one, the injury to the SMV was noticed immediately and primarily repaired laparoscopically. In the other, the injury was only diagnosed later on during the operation after the small bowel became edematous and the site of vascular ligation was explored. In the other three patients, damage to the SMV was either missed or underappreciated and its magnitude only fully elucidated during relaparotomy. Relaparotomy was performed after these patients developed hemodynamic instability (2/3), lactic acidosis (3/3), abdominal compartment syndrome (1/3), and excessive fluid discharge from abdominal drains (1/3).

Reconstruction

Out of the five patients in this case series, three underwent venous vascular reconstruction by a great saphenous vein graft and two patients underwent primary suture repair of the damaged vein. Out of the three venous graft reconstructions, two remained patent on second look with salvage of the small

bowel. One of the venous graft reconstructions required a second vascular repair using a bovine venous graft. This attempted venous reconstruction also failed and the patient eventually succumbed to postoperative sepsis.

Discussion

In colorectal cancer surgery, regional lymphadenectomy provides important prognostic information and guides postoperative management. CME, which involves the en bloc removal of the tumor-bearing colon and the associated mesentery, should be performed routinely. Preservation of the mesocolic plane by dissection off the parietal plane and ligation of the mesenteric vessels near their origin are an integral part of CME. In order to perform an oncological adequate resection of the right colon, the surgeon needs to ligate the right branch of the middle colic artery and vein at the root of the mesentery close to the third part of the duodenum and inferior border of the pancreas. At this stage, care should be taken to avoid injury to the SMV. The peritoneum overlying the vascular pedicle should be incised and the vessels clearly identified. This can be facilitated by completely freeing the hepatic flexure from the duodenum and the head of the pancreas.

Mechanisms of injury

From reviewing our operative notes, we were able to propose several possible mechanisms by which SMV injury can occur.

Anatomic variations and misperception

Arterial and venous branching patterns within the root of the mesentery are variable, variations such as multiple MCA (7.2–36 %), different lengths and origins of the gastro-colic venous trunk of Henle, and variations in the pattern of the venous drainage of the MCV are common and should be taken into consideration by the operating surgeon [4].

Avulsion of the middle colic vein due to excessive traction

Another possible cause of the SMV mistakenly identified as the MCV occurs during surgery with excessive tenting and pulling of mesenteric vessels. Tenting causes the MCV to run parallel to the SMV, distorting the anatomical relations and causing the SMV to be more prone to injury, especially during oncologic surgery when ligation of the vessels close to their origin is required.

With the advancement of laparoscopic surgery, incisions for right colectomy tend to be smaller and the danger of avulsion injuries of colonic vasculature and mainly venous vessels seemed to increase. Pulling on the right colonic vessels occurs both in the intra-peritoneal portion of the operation as well as in the extra-peritoneal portion of the operation. During the intra-peritoneal portion of the operation, the right and middle colic vessels are put under tension in order to visualize the colonic vessels for clipping and resection. Pulling of these vessels, mainly the venous ones, which are very thin walled and friable, may cause avulsion of veins and profuse venous bleeding which is often difficult to control both in the laparoscopic and open approaches.

SMV injury can also occur during open right colectomy by way of excessive medial retraction of the hepatic flexure. During such a maneuver, tearing of the MCV close to the SMV can occur, causing profuse and difficult to control bleeding [5]. The initial tendency of many surgeons in this event is to clip or suture what seems to be the source of bleeding. However, often what seems to be the source of bleeding is only a small and hard to identify branch which keeps bleeding despite allegedly being clipped. At this point, it is recommended to achieve complete exposure of the SMV in order to avoid injury by mass ligation or blind suturing.

Another mechanism described in our cases leading to avulsion of the venous vasculature and consequent bleeding is the en masse pulling of the colon to be resected through a too small incision in the abdominal wall. This attempt to remove a bulky colon through a small incision to improve cosmesis of minimally invasive surgery can lead to tearing of venous vessels and a life threatening venous bleeding.

Mesentery involved by tumor

In one of our cases, a large hepatic flexure tumor extended to the transverse mesocolon creating traction and distortion of the middle colic vessels. In this case, the SMV was avulsed laparoscopically while trying to gain access the origin of the MCV. In this situation, it would be wise not to insist on performing central vascular ligation as the chances to achieve complete oncological resection are low and the potential hazard to the patient's life as a result of damage to the SMV is high.

Methods of repair

In our review of the literature, we found no clear guidelines or recommendations as to the preferred means of venous reconstruction in the setting of iatrogenic SMV injury during right colectomy. In this setting, we believe that revascularization by

a trained vascular surgeon should be attempted whenever possible in order to prevent bowel ischemia and its sequelae. Also, we wish to emphasize the importance of practicing a second look operation within 24 hours to assess small bowel viability and SMV patency.

In summary

Right colectomy is considered by many surgeons to be a simple and safe procedure for both benign and malignant indications. However, several technical pitfalls await the operating surgeon with SMV injury being one of the most serious and potentially fatal.

In this case series, we have presented our experience with a relatively rare, but underreported, intraoperative complication of SMV injury during right colectomy for adenocarcinoma. We suggested several mechanisms which may lead to such venous injury.

We believe that increased awareness of this complication with profound understanding of vascular anatomy and the different mechanisms of injury will allow surgeons to avoid complications and allow for prompt and adequate management if such injury is encountered.

Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interests.

Ethical approval This study was performed in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. A waiver of consent was granted since this is a retrospective chart review study.

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